CORRES. CONTROL
INCOMING LTR NO.

01345 RF 94

DUE
DATE

ACTION DIST.	LTR	ENC
BERMAN, H.S.		
CARNIVAL, G.J.		
COPP, R.D.		
CORDOVA, R.C.		
DAVIS, J.G.		
FERRERA, D.W.		
FRANZ, W.A.		
HANNI, B.J.		
HEALY, T.J.		
HEDAHL, T.G.	X	X
HILBIG, J.G.		
HUTCHINS, N.M.		
KELL, R.E.		
KIRBY, W.A.		
KUESTER, A.W.		
MAHAFFEY, J.W.		
MANN, H.P.		
MARX, G.E.		
McKENNA, F.G.		
MORGAN, R.V.		
PIZZUTO, V.M.		
POTTER, G.L.		
SANDLIN, N.B.		
SATTERWHITE, D.G		
SCHUBERT, A.L.	X	X
SETLOCK, G.H.		
STIGER, S.G.	X	X
SULLIVAN, M.T.		
SWANSON, E.R.		
WILKINSON, R.B.		
WILSON, J.M.		
Broussard M	X	X
Burmeister M	X	X
Demos N	X	X
Johnson M	X	X
Myrick S	X	X
Vess M	X	X

CORRES CONTROL	x	x
ADMN RECORD/080	X	X
PATS/ T130G		

Reviewed for Addressee
Corres. Control RFP

4/5/94 CM
DATE BY

Ref Ltr. #

DOE ORDER # 5400.1

RF-46522 (Rev. 01/94)

Department of Energy

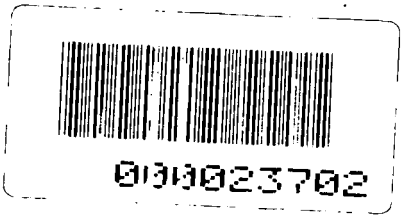
ROCKY FLATS OFFICE
P.O. BOX 928
GOLDEN, COLORADO 80402-0928

APR 5 2 11 PM '94

APR 1 1994

ECCG
ROCKY FLATS PL
CORRESPONDENCE

94-DOE-03459



Frederick R. Dowsett, Ph.D., Chief
Colorado Department of Health
Monitoring and Enforcement
4300 Cherry Creek Drive South
Denver, Colorado 80222-1530

Dear Dr. Dowsett:

Enclosed is the Resource Conservation and Recovery Act Contingency Plan Implementation Report No. 94-004, which documents the status and information concerning the release to the environment of surface water containing hazardous waste constituents. This release originated from the transfer piping associated with Operable Unit (OU) No. 2 treatment unit. The surface water is diverted from Walnut Creek as part of the Interim Measure/Interim Remedial Action (IM/IRA) for OU-2. This diverted water is normally treated in a Chemical Precipitation/ Microfiltration/Granular Activated Carbon System to remove contaminants from the water. The treated water is then returned to the creek.

In addition to the enclosed report, an errata sheet has been enclosed to correct and expand on the report. This errata sheet was determined to be necessary, as opposed to waiting for an additional report revision.

It is the recommendation of the U.S. Department of Energy (DOE) Rocky Flats Office that the March 10, 1994, release be included in the next quarterly update of the Historical Release Report (HRR) due to the fact that the State water quality standard for tetrachloroethylene was exceeded. We believe that the HRR and the Rocky Flats Plant (RFP) Interagency Agreement (IA), of which the HRR is a requirement, are the appropriate vehicles for dealing with releases of this nature that do not pose an immediate and acute hazard to human health and the environment. In addition, the IA has been incorporated into the RFP Part B Resource Conservation and Recovery Act Permit. Thus, we believe that using the IA to address new releases, when appropriate, is consistent with the Permit.

We apologize for the delay regarding the transmittal of the enclosed report. Corrections were required to provide a hazard assessment consistent with the Colorado Department of Health's (CDH's) February 11, 1994, letter to the DOE and the CDH "Interim Final Policy and Guidance on Risk Assessments for Corrective Action at RCRA Facilities" dated November 16, 1993. Please note that an earlier draft copy of this report was faxed to your office for review on March 23, 1994.

Any concerns or comments you may have regarding the enclosed report should be addressed to Vern Witherill of my staff at 966-7003. We will work diligently to make any modifications to the report that you deem to be appropriate.

Sincerely,

Jessie Roberson
Acting Assistant Manager for
Environmental Restoration

Enclosures:

cc w/Enclosure:
D. Maxwell, EPA
M. Silverman, ER, RFO
B. Brainard, OC, RFO
D. Grosek, EMB, RFO
T. Lukow, WPD, RFO
W. Seyfert, RPB, RFO
V. Witherill, ER, RFO
B. Williamson, ER, RFO
M. Broussard, EG&G
M. Burmeister, EG&G
S. Stiger, EG&G
N. Demos, EG&G
T. Hedahl, EG&G
M. Johnson, EG&G
S. Myrick, EG&G
A. Schubert, EG&G
M. Vess, EG&G

EG&G ROCKY FLATS

EG&G ROCKY FLATS, INC.
ROCKY FLATS PLANT, P.O. BOX 464, GOLDEN, COLORADO 80402-0464 • (303) 966-7000

March 31, 1994

94-RF--03862

J. Roberson
Environmental Restoration
DOE, RFO

UPDATED RESOURCE CONSERVATION AND RECOVERY ACT (RCRA) CONTINGENCY PLAN IMPLEMENTATION REPORT (CPIR) NO. 94-004 (5400.1) - TGH-154-94

Enclosed is the updated RCRA CPIR No. 94-004 which outlines the events associated with the release to the environment of surface water containing hazardous waste constituents. This release originated from the transfer piping associated with Operable Unit (OU) No. 2 treatment unit. The updated report was revised to address your comments received on March 31 to our submittal of CPIR on March 23, 1994. These revisions include corrections toTables 1 and 2, inclusion of an additional table of analytical data, and revisions to section 7.

If you have any questions regarding this matter please call M. C. Broussard at extension 8517, or M. C. Burmeister.

T. G. Hedahl, Associate General Manager
Environmental and Waste Management

EMP:mlj

Orig. and 1 cc - J. Roberson

Enclosures:
As Stated (1)

ERRATA SHEET FOR RCRA CONTINGENCY PLAN REPORT NO. 94-004

(1) Item 7, Page 4 of 7, Paragraph 2, lines 8 through 10 - Inspection of Table 1 indicates that volatile organic compound concentrations in water are not significantly different in the May, 1993 data versus the March 10, 1994 data.

(2) Item 7, Page 4 of 7, Paragraph 2, lines 14 through 16 - Delete this sentence.

(3) Item 7, Page 5 of 7, Paragraph 1, line 3 - replace 0.00008 mg/L with 0.0008 mg/L.

(4) Item 7, page 5 of 7, Paragraph 2 -

- (a) The soil risk assessment for the December 4, 1993 release used the analytes and their concentrations from the May, 1993 sampling data presented in Table 1. This is reportedly the most recent validated data available.
- (b) The soil risk assessment for the December 4, 1993 release is assumed to be valid for the March 10, 1994 release since the same validated data set for the water analysis applies to both releases
- (c) Comparison of the analyte concentrations of May, 1993 versus March 10, 1994 presented in Table 1 indicates that the soil risk assessment using the May, 1993 data is representative of the March 10, 1994 data.

(5) Table 1, Column 2 -

- (a) The carbon tetrachloride J-value for the March 10, 1994 data is reported to be 0.002 mg/L.
- (b) All of the second numbers to the right of the "/" in this column should be enclosed by parentheses and identified by footnote as being the March 10, 1994 unvalidated data. The data to the left of the "/" represent the validated data from May, 1993.

RCRA CONTINGENCY PLAN
Implementation Report No. 94-004

RCRA CONTINGENCY PLAN
IMPLEMENTATION REPORT
ROCKY FLATS PLANT
EPA ID NUMBER CO7890010526

This report is made in compliance with the requirements of 6 CCR 1007-3, Part 265.56 (j) for a written report within 15 days of the implementation of the RCRA Contingency Plan. The requirements for this report are given below and will be addressed in the order listed, excerpted from 6 CCR 1007-3, Part 265.56:

"(j)...Within 15 days after the incident, he must submit a written report on the incident to the department. The report must include:

(1) Name, address, and telephone number of the owner or operator
(2) Name, address, and telephone number of the facility
(3) Date, time, and type of incident (fire, explosion)
(4) Name and quantity of material(s) involved
(5) The extent of injuries, if any
(6) An assessment of actual or potential hazards to human health and the environment, where this is applicable; and
(7) Estimated quantity and disposition of recovered material resulted from the incident."

---

(1) NAME, ADDRESS AND TELEPHONE NUMBER OF THE OWNER OF THE FACILITY:

United States Department of Energy
Rocky Flats Plant
Post Office Box 928
Golden, Colorado 80402
(303) 966-2025

Facility Contact:
M. N. Silverman, Manager

(2) NAME, ADDRESS AND TELEPHONE NUMBER OF THE FACILITY:

U.S. Department of Energy
Rock Flats Plant
Post Office Box 928
Golden, Colorado 80402
(303) 966-2025

(3) DATE, TIME, AND TYPE OF INCIDENT:

A. SUMMARY:

The RCRA Contingency Plan was implemented on March 10, 1994, due to a release to the environment of approximately 200 gallons of surface water containing hazardous waste constituents. It was later determined that possibly up to 6,000 gallons were released from the primary piping, flowed through secondary piping, and were released to the SW-61 collection point. Normally 97% of the water diverted to the influent line feed system originates from the SW-61 collection point.

The water is diverted from the three collection points including a seep, surface water drainage, and Walnut Creek. This partial diversion of this water is part of the Interim Measure/Interim Remedial Action (IM/IRA) for OU 2. This diverted water is treated in a Chemical Precipitation/ Microfiltration/Granular Activated Carbon System. The treated water is then returned to the creek.

The RCRA Contingency Plan was implemented as required by the Rocky Flats Plant (RFP) RCRA Permit because the release to the environment (soil and surface water) was greater than one pound of hazardous waste (surface water containing F-listed hazardous waste constituents).

B. SYSTEM DESCRIPTION:

The system involved with this incident was originally installed in May 1991. The partial diversion system collects water at three points (SW-59, SW-61, and SW-132, reference Figure 1) for the transfer of seep, surface water, and creek water to the treatment system. The water diverted from SW-132 is transferred to SW-61 collection point prior to pumping this water to the treatment facility. The influent line from SW-59 ties into the main influent downstream of the SW-61 collection point. The system is designed to divert 60 gallons per minute to the OU 2 treatment unit. Any excess water will overflow the weirs and enter Walnut Creek.

The influent line is approximately 1000 feet from the inlet at the creek to the primary tank system. The influent line is a 2-inch primary pipe contained within a 3-inch secondary pipe. The line is insulated with styrofoam and is heat traced for winter operation. The line feeds into the treatment system that consists of numerous tanks, filters, and treatment columns. (See Figure 2 for a diagram of the treatment system.) The potentially contaminated water is treated for removal of volatile organic, soluble metals, and radioactive constituents. The OU 2 treatment facility is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) IM/IRA facility. No Individual Hazardous Substance Site (IHSS) was involved in this incident.

C. DESCRIPTION OF INCIDENT:

A release of surface water containing hazardous waste constituents from the influent pipe system leading from Walnut Creek to the treatment system occurred due to a separation in the primary and secondary piping. The release was discovered at 5:50 a.m. on Wednesday, March 10, 1994. The pipeline had been visually inspected eight hours prior to the discovery of the release.

The influent flow totalizer meter showed a marked decrease in the amount of water entering the system; therefore, the contractor proceeded to visually

inspect the influent line. The primary and secondary piping were found to be separated approximately 800 feet from the treatment unit (approximately 200 feet above SW-61 collection point, reference Figure 1). The amount of material released to the soil was estimated to be approximately 200 gallons based on a visual determination of the size of the wetted area. In addition, possibly up to 6,000 gallons of diverted water released from the primary piping flowed through the secondary containment portion of the pipeline and was released into the SW-61 collection point. Approximately 97% of the water diverted is collected from SW-61.

The contractor immediately shut down the inlet pumps to the pipeline and notified the project manager. The manager notified the Shift Superintendent and the Operations Manager at 6:05 a.m. who then notified the Emergency Operations Center (EOC).

On March 10, samples were taken of the influent water and the soil in the area affected by the release to confirm the concentration of hazardous waste constituents in the water and affected soil.

D. CORRECTIVE ACTION:

The pumps were de-energized immediately after the leak was discovered. Subcontractor personnel immediately began repairs on the pipe. The pipeline was repaired and the system was back in operation at 11:25 a.m. on March 10, 1994. The pump was re-energized and the system was returned to normal operation. A verbal notification that operations were resumed was made to CDH by the EOC at 9:30 a.m. on March 11, 1994.

It is believed that the root cause of this incident is directly related to the quality of the primary and secondary piping used to transport the influent feed to OU 2 treatment unit. The results of an evaluation indicate that the piping is showing signs of aging, and while there is a preventative maintenance program in effect, equipment failures are continuing to plague the facility. A decision has been made prior to this incident to replace the influent piping. A schedule for replacing the influent line will be provided to the Colorado Department of Health (CDH) by April 15, 1994. The new line will be certified by a independent, qualified, registered, professional engineer as required by 6 CCR 1007-3, Part 265.196(f). A copy of the certification will be provided to CDH within seven days after the new line is placed into service.

(4) EQUIPMENT STATUS:

The system was repaired and returned to normal operation on March 10, 1994, at 11:25 a.m. The daily inspections of the pipeline are continuing.

(5) QUANTITY AND NAME OF MATERIAL INVOLVED:

It is estimated that approximately 200 gallons were released to the soil based on the area wetted by the release. In addition, it is estimated that possibly up to 6,200 gallons of water were released from the primary piping, flowed through the secondary containment, and were released into SW-61 collection point (the source of 97% of the diverted water).

The water that was released is collected from SW-59, SW-61 and SW-132 [most of which is surface runoff from within the Protected Area (PA)]. Due to the fact that this groundwater and surface water feeding Walnut Creek can contain hazardous waste constituents, a determination has been made by EG&G Rocky Flats, Inc. that the "contained in" rule is applicable, and the water entering the OU 2 treatment system contains "F001" listed hazardous waste. This waste determination was based on analytical results from routine sampling. The water is sampled weekly to determine the concentration of the hazardous waste constituents in the water. F001 listed hazardous waste constituents have been detected in trace amounts in the influent water. Analytical results from sampling eventsin May 1993 are summarized in Table 1. Based on this historical data, the F001 listed contaminants that have been detected include carbon tetrachloride, trichloroethene and tetrachloroethene. Cis 1,2-dichloroethene, chloroform, 1,1-dichloroethane and Toluene have been detected in the influent water but not at levels that would make the water a characteristic hazardous waste.

On March 10, special samples were taken at two locations of the soil wetted by the release. In addition, a sample was taken of the water remaining in the secondary containment portion of the pipeline. Based on the preliminary results of the volatile organic analysis, tetrachloroethene was detected at a level below the Practical Quantitation Level (PQL) in one soil sample and no volatile organics were detected in the second soil sample. The volatile organics detected in the water sample include 1,2 dichloroethene (9 ppb), trichloroethene (5 ppb), and tetrachloroethene (5 ppb). In addition, 1,1,1-trichloroethane and carbon tetrachloride were detected in the water sample but the detection levels were below the PQLs.

(6) EXTENT OF INJURIES:

There were no injuries as a result of this incident.

(7) AN ASSESSMENT OF ACTUAL OR POTENTIAL HAZARD TO HUMAN HEALTH AND ENVIRONMENT:

Based on the historical analytical data (which indicates very low concentration levels of hazardous waste constituents) and the result of a previous risk assessment, a decision was made on March 10, 1994 not to immediately remove the soil impacted by the release. The initial decision was verified by a second risk assessment using the CDH methodology which resulted in even a lower risk (10^{-8}).

Comparisons of the release water (approximately 6200 gallons) with Safe Drinking Water Act Maximum Contaminant Levels (MCL's), Resource Conservation and Recovery Act TCLP, and Colorado Water Quality Standards for Segment 5 of Big Dry Creek are shown in Tables 1 and 2. Analytical data for volatile organic compounds, the chemicals of interest for this release, are presented in Table 1. Influent water maximum and average concentrations from samples collected from May 1993 are provided along with influent water concentrations taken on March 10, 1994, the date of the release. The March 10, 1994 data have not yet been validated. However, it is apparent that concentrations are significantly less than the concentrations of samples collected in May 1993. With regard to MCL's, the March 10, 1994 data are not in excess of the standards. However, for both tricholoroethene (TCE) and tetrachloroethylene (PCE), concentrations were equal to the MCL's. With regard to the State standards, only PCE exceeded the standard (0.005 mg/L vs. 0.0008 mg/L). Comparison of average concentrations from May, 1993 with MCL's and state standards indicate that TCE, PCE, carbon tretrachloride and 1,1-Dichloroethene exceed the standards. Thus, it is evident that the contaminated water released on March 10, 1994 exceeded the State standard for PCE.

Assuming that the colorado Water Quality Standards for Segment 5 of Big Dry Creek are protective of aquatic life, the only concern is the concentration of PCE in excess of 0.00008 mg/L.

A risk assessment was performed for soil contacted by 10 gallon OU 2 release on December 4, 1993. This risk assessment is provided as an attachment to this report and is consistent with the Colorado Department of Health's November 16, 1993 "Interim Final Policy and Guidance on Risk Assessments for Corrective Actions at RCRA Facilities". The risk posed to a residential receptor by the assumed soil contamination is between 1EE-7 and 1EE-8, or an excess cancer risk of between 1 in 10 million to 1 in 100 million. This, the risk is below 1EE-6 and is not considered to be a significant human health risk.

It should be noted that the OU 2 treatment system is sized to treat 60 gallons per minute. Periodically the amount of water inflowing to the collection points (SW-59, SW-61, and SW-132) exceeds this capacity' therefore, the excess water overflows the weirs and enters Walnut Creek. The initial assessment of the impact of the 6,000 gallon release back to SW-61 collection point was that this release was indistinguishable from the excess water which periodically overflows the weirs.

(8) ESTIMATE QUANTITY AND DISPOSITION OF RECOVERED MATERIAL THAT RESULTED FROM THE INCIDENT:

Based on the initial assessment of the actual or potential threat to human health and environment, none of the material which wetted the soil or flowed into the creek were recovered.

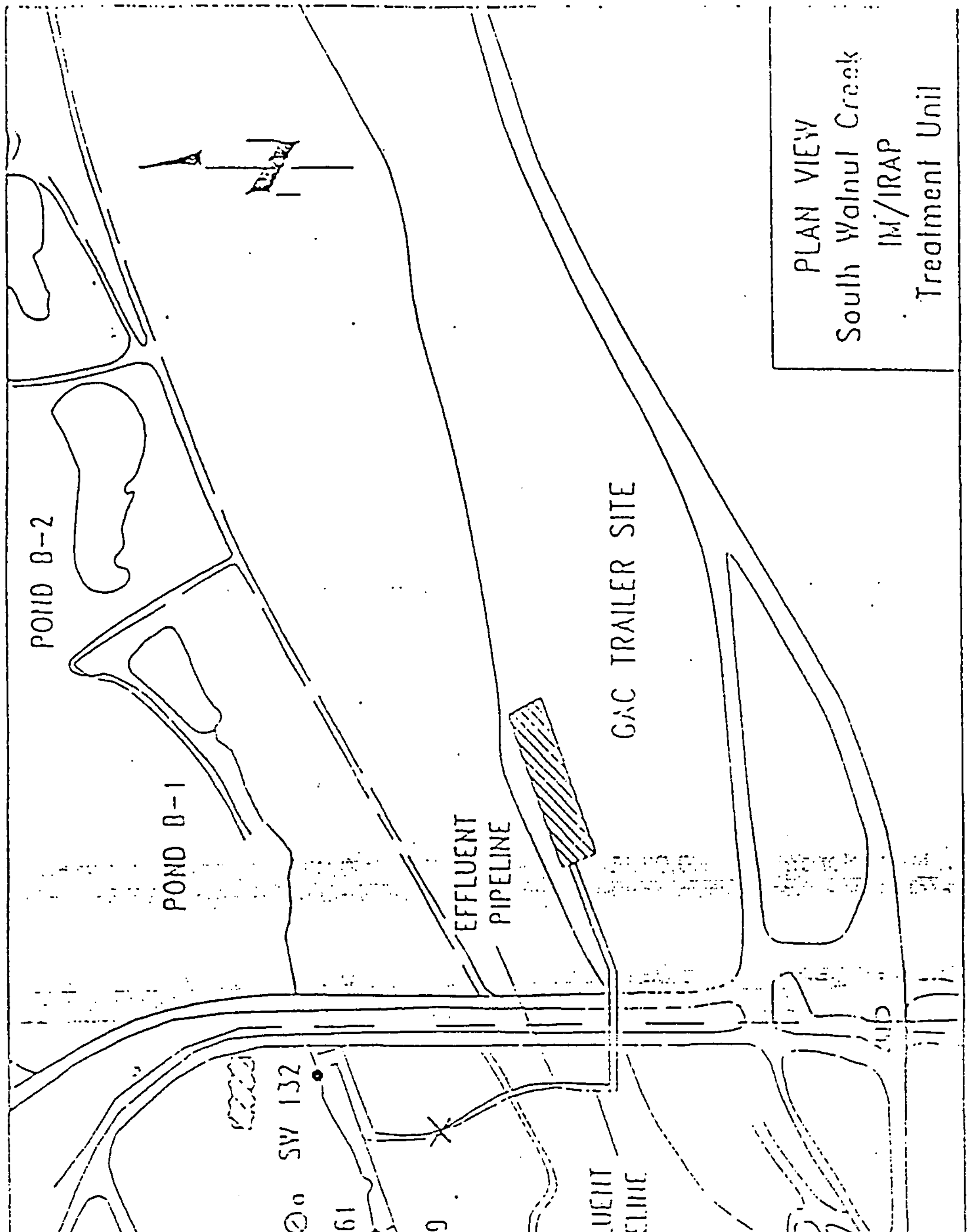
TABLE 1
VOLATILE ORGANIC COMPOUNDS **

Analyte	Value Detected Analytical Results (mg/L)	SDWA MCLs (mg/L)	RCRA TCLP Regulatory Limit (mg/L)
Trichlorethylene (F001) (D040)	.003/.005	0.005	0.50
Carbon tetrachloride (F001) (D019)	.003/J	0.005	0.50
Tetrachloroethylene (F001) (D039)	.002/.005	0.005	0.70
Cis-1,2-dichloroethylene	.009/ .009*	0.070	-
Toluene	.0004/ND	-	-
1,1-Dichloroethene (D029)	.0008/ND	0.007	0.07
Chloroform (D022)	.0007/ND	-	6.00

SDWA - Safe drinking Water Act
MCLs - Maximum Contaminant Levels
"-" No Standards Listed
* Cis and Trans 1,2-dichloroethylene totals combined
** Based on sampling events from May 1993 (Most recent validated data)
J Compound found, but below PQL. Quantitation is estimated.
ND Not detected

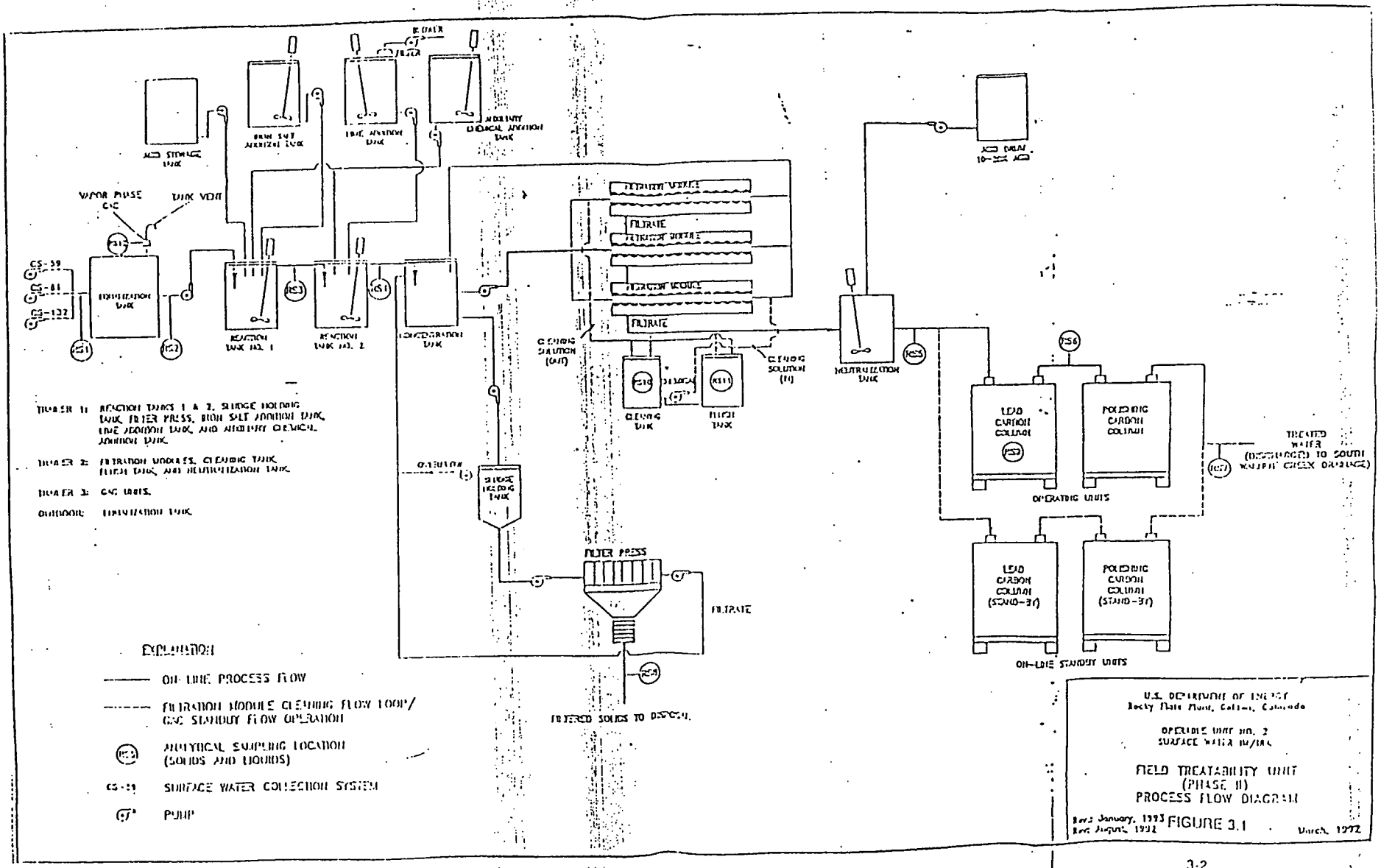
TABLE 2
VOLATILE ORGANIC COMPOUNDS

Analyte	Colorado Water Quality Standards (Big Dry Creek Segment 5) (mg/L)
Trichloroethene (F001 (D040)	0.066
1,2-Dichlorethene (cis- and trans-)	0.170
Carbon Tetrachloride (F001) (D019)	0.018
Tetrachoroethylene (F001) (D039)	0.0008
Methylene Chloride (F001)	0.0047
1,1-Dichloroethene (D029)	0.000057
Chloroform (D022)	0.006



X Approximate location of leak

FIGURE 1



Bounding Risk Assessment for OU2

A revised risk assessment was performed on the small spill of water present in the OU 2 Treatability System. Instead of using chemical concentrations in water, the revised assessment is based on extrapolated chemical concentrations in soil, as requested by CDH.

Attached are the computer spreadsheets for a screening-level assessment of human health risks. The spreadsheet format, exposure parameters, parameter default values, and the intake equations follow the CDH Interim Final Guidance for risk assessments used to determine the need for a Corrective Measures Study (CMS) at a RCRA facility (CDH, 1993).

As shown in the lower right-hand corner of Table 2, the estimated upper-bound total added cancer risk from ingestion of soil, dermal contact with soil, and inhalation of soil particles by the future on-site resident at OU 2 is between 1E-7 and 1E-8, or an added cancer incidence between 1 in 10 million and 1 in 100 million. The risk screening threshold proposed by CDH for making a determination of need for a CMS is a cumulative risk of 1E-6. Thus, using the CDH screening-level risk assessment methodology, the small spill at OU 2 appears to present a potential cancer risk level at least one order of magnitude less than the CDH screening threshold.

As shown in the lower right-hand corner of Table 3, the estimated upper-bound total HQ (Hazard Quotient) for noncancer health effects is between 1E-02 and 1E-03, or between 0.1% and 1% of the cumulative risk screening threshold proposed by CDH (HQ=1). Thus, using the CDH methodology, the small spill at OU 2 appears to present a potential noncancer health risk level at least two orders of magnitude less than the CDH screening threshold.

Because measured soil concentrations of seven COCs (Chemicals of Concern) identified in the water spilled at the OU 2 Field Treatability Unit were unavailable, it was necessary to extrapolate maximum surface soil concentrations on the very conservative basis of 40% soil moisture at saturation, i.e., the measured water concentrations were multiplied by 0.4 to estimate maximum soil concentrations. A maximum soil moisture of 40% is generally typical of a moderately compacted soil; actual maximum soil moisture recorded at OU 2 is about 30%, with an average nearer to 20%, according to OU 2 records.

This specific application of CDH's proposed RCRA screening-level risk assessment methodology to a very small spill at OU 2 (viz., 10 gallons) appears to indicate no need for a CMS, at least on the basis of soil-related risks (CDH proposes that water will be screened on the basis of an ARAR rather than a risk level). Still, it appears that the risk levels projected using the CDH methodology can overstate the reasonable upper-bound risks by many orders of magnitude. As a means of supporting this conclusion, the exposure assessment scenario implicit in the CDH default exposure factors and intake equations is outlined in Attachment 2 as it applies to the 10-gallon spill at OU-2.

TABLE 1								
RESIDENTIAL EXPOSURE QUANTIFICATION–Intake Calculation: OU-2 Spill at Field Treatability Unit								
Max Concentration (Cmax) at SWMU or CAMU	Contaminant of Concern (COC)							
	cis-1,2 DCE		1,1 DCA		TCE		PCE	
Modelled:								
Surface Soil (mg/kg) (1)	3.60E-03	3.60E-03	3.20E-04	3.20E-04	1.20E-03	1.20E-03	8.00E-04	8.00E-04
Airborne Soil Particulates (mg/m3) (2)	7.80E-07	7.80E-07	6.40E-08	6.40E-08	2.60E-07	2.60E-07	1.70E-07	1.70E-07
Indoor Airborne Soil VOCs (mg/m3)	NA	NA	NA	NA	NA	NA	NA	NA
Route of Exposure and Intake (Imax)	Noncar-cinogen (NC)	Carcino-gen (C)	Noncar-cinogen (NC)	Carcino-gen (C)	Noncar-cinogen (NC)	Carcino-gen (C)	Noncar-cinogen (NC)	Carcino-gen (C)
SOIL INGESTION:								
Child Intake (mg/kg-d) (3)(4)	4.60E-07	3.95E-08	4.09E-08	3.51E-09	1.53E-07	1.32E-08	1.02E-07	8.77E-09
Adult Intake (mg/kg-d) (5)(6)	4.93E-08	1.69E-08	4.38E-09	1.50E-09	1.64E-08	5.64E-09	1.10E-08	3.76E-09
TOTAL INTAKE	5.10E-07	5.64E-08	4.53E-08	5.01E-09	1.70E-07	1.88E-08	1.13E-07	1.25E-08
SOIL DERMAL CONTACT:								
Child Intake (mg/kg-d) (7)(8)	5.29E-06	4.54E-07	4.71E-07	4.03E-08	1.76E-06	1.51E-07	1.18E-06	1.01E-07
Adult Intake (mg/kg-d) (9)(10)	1.75E-06	6.00E-07	1.56E-07	5.34E-08	5.84E-07	2.00E-07	3.89E-07	1.33E-07
TOTAL INTAKE	7.04E-06	1.05E-06	6.26E-07	9.37E-08	2.35E-06	3.51E-07	1.57E-06	2.34E-07
SOIL PARTICLE INHALATION:								
Child Intake (mg/kg-d) (11)(12)	1.89E-15	1.62E-16	1.55E-16	1.33E-17	6.29E-16	5.39E-17	4.11E-16	3.52E-17
Adult Intake (mg/kg-d) (13)(14)	4.60E-16	1.58E-16	3.77E-17	1.29E-17	1.53E-16	5.25E-17	1.00E-16	3.44E-17
TOTAL INTAKE	2.35E-15	3.19E-16	1.93E-16	2.62E-17	7.82E-16	1.06E-16	5.11E-16	6.96E-17

Max Concentration (Cmax) at SWMU or CAMU	Contaminant of Concern (COC)					
	Carbon Tet		Chloroform		Toluene	
Modelled:						
Surface Soil (mg/kg) (1)	1.20E-03	1.20E-03	2.80E-04	2.80E-04	1.60E-04	1.60E-04
Airborne Soil Particulates (mg/m3) (2)	2.60E-07	2.60E-07	6.00E-08	6.00E-08	3.50E-08	3.50E-08
Indoor Airborne Soil VOCs (mg/m3)	NA	NA	NA	NA	NA	NA
Route of Exposure and Intake (Imax)	Noncar-cinogen (NC)	Carcino-gen (C)	Noncar-cinogen (NC)	Carcino-gen (C)	Noncar-cinogen (NC)	Carcino-gen (C)
SOIL INGESTION:						
Child Intake (mg/kg-d) (3)(4)	1.53E-07	1.32E-08	3.58E-08	3.07E-09	2.05E-08	1.75E-09
Adult Intake (mg/kg-d) (5)(6)	1.64E-08	5.64E-09	3.84E-09	1.32E-09	2.19E-09	7.51E-10
TOTAL INTAKE	1.70E-07	1.88E-08	3.96E-08	4.38E-09	2.26E-08	2.50E-09
SOIL DERMAL CONTACT:						
Child Intake (mg/kg-d) (7)(8)	1.76E-06	1.51E-07	4.12E-07	3.53E-08	2.35E-07	2.02E-08
Adult Intake (mg/kg-d) (9)(10)	5.84E-07	2.00E-07	1.36E-07	4.67E-08	7.78E-08	2.67E-08
TOTAL INTAKE	2.35E-06	3.51E-07	5.48E-07	8.20E-08	3.13E-07	4.68E-08
SOIL PARTICLE INHALATION:						
Child Intake (mg/kg-d) (11)(12)	6.29E-16	5.39E-17	1.45E-16	1.24E-17	8.47E-17	7.26E-18
Adult Intake (mg/kg-d) (13)(14)	1.53E-16	5.25E-17	3.54E-17	1.21E-17	2.06E-17	7.07E-18
TOTAL INTAKE	7.82E-16	1.06E-16	1.81E-16	2.46E-17	1.05E-16	1.43E-17

Note: (1) Cmax (mg/kg) = Cmax (mg/L)*0.4 (40% soil moisture at saturation in moderately compacted soil).

Note: (2) Cmax (mg/m3) = Cmax (mg/kg)/4630 m3/mg (PEF, particulate emission factor from EPA RAGS, Part B).

Note: (3) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.3E-4 (CDH RCRA standard default intake factor).
(4) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.1E-5 (CDH).

Note: (5) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*1.4E-5 (CDH).
(6) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*4.7E-6 (CDH).

Note: (7) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.5E-3 (CDH).
(8) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.3E-4 (CDH).

Note: (9) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*4.9E-4 (CDH).
(10) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*1.7E-4 (CDH).

Note: (11) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.9E-15 (CDH).
(12) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.6E-16 (CDH).

Note: (13) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*4.6E-16 (CDH).
(14) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*1.6E-16 (CDH).

TABLE 2							
RESIDENTIAL RISK CHARACTERIZATION–							
Risk Calculation for Carcinogens: OU-2 Spill at Field Treatability Unit							
	Contaminant--Carcinogen						
Route of Exposure and Risk (Rmax)	cis-1,2 DCE	1,1 DCA	TCE	PCE	Carbon Tet	Chloro-form	Toluene
SOIL INGESTION							
Total Intake (mg/kg-day)*	5.64E-08	5.01E-09	1.88E-08	1.25E-08	1.88E-08	4.38E-09	2.50E-09
Slope Factor (mg/kg-day)-1=	NA	NA	1.10E-02	5.20E-02	1.30E-01	6.10E-03	NA
Added Cancer Risk	NA	NA	2.07E-10	6.51E-10	2.44E-09	2.67E-11	NA
SOIL DERMAL CONTACT							
Total Intake (mg/kg-day)*	1.05E-06	9.37E-08	3.51E-07	2.34E-07	3.51E-07	8.20E-08	4.68E-08
Slope Factor (mg/kg-day)-1=	NA	NA	1.10E-02	5.20E-02	1.30E-01	6.10E-03	NA
Added Cancer Risk	NA	NA	3.86E-09	1.22E-08	4.57E-08	5.00E-10	NA
SOIL PARTICLE INHALATION							
Total Intake (mg/kg-day)*	3.19E-16	2.62E-17	1.06E-16	6.96E-17	1.06E-16	2.46E-17	1.43E-17
Slope Factor (mg/kg-day)-1=	NA	NA	6.00E-03	2.00E-03	5.30E-02	8.10E-02	NA
Added Cancer Risk	NA	NA	6.39E-19	1.39E-19	5.64E-18	1.99E-18	NA
Total Residential Contaminant--Specific Added Cancer Risk	NA	NA	4.07E-09	1.28E-08	4.81E-08	5.27E-10	NA
TOTAL RESIDENTIAL ADDED CANCER RISK							6.55E-08

TABLE 3 RESIDENTIAL RISK CHARACTERIZATION– Risk Calculation for Noncarcinogens: OU-2 Spill at Field Treatability Unit							
	Contaminant--Noncarcinogen						
Route of Exposure and Risk (Rmax)	cis-1,2 DCE	1,1 DCA	TCE	PCE	Carbon Tet	Chloro-form	Toluene
SOIL INGESTION							
Total Intake (mg/kg-day)/	5.10E-07	4.53E-08	1.70E-07	1.13E-07	1.70E-07	3.96E-08	2.26E-08
Reference Dose (mg/kg-day)=	1.00E-02	1.00E-01	NA	1.00E-02	7.00E-04	1.00E-02	2.00E-01
Hazard Quotient	5.1E-05	4.53E-07	NA	1.13E-05	2.43E-04	3.96E-06	1.13E-07
SOIL DERMAL CONTACT							
Total Intake (mg/kg-day)/	7.04E-06	6.26E-07	2.35E-06	1.57E-06	2.35E-06	5.48E-07	3.13E-07
Reference Dose (mg/kg-day)=	1.00E-02	1.00E-01	NA	1.00E-02	7.00E-04	1.00E-02	2.00E-01
Hazard Quotient	7.04E-04	6.26E-06	NA	1.57E-04	3.35E-03	5.48E-05	1.57E-06
SOIL PARTICLE INHALATION							
Total Intake (mg/kg-day)/	2.35E-15	1.93E-16	7.82E-16	5.11E-16	7.82E-16	1.81E-16	1.05E-16
Reference Dose (mg/kg-day)=	NA	1.00E-01	NA	NA	NA	NA	NA
Hazard Quotient	NA	1.93E-15	NA	NA	NA	NA	NA
Total Residential Contaminant–Specific Hazard Quotient	7.55E-04	6.71E-06	NA	1.68E-04	3.60E-03	5.87E-05	1.68E-06
TOTAL RESIDENTIAL HAZARD QUOTIENT							4.59E-03

EXPOSURE ASSESSMENT SCENARIO
OU-2 TREATABILITY WATER SPILL

As the CDH methodology does not permit any soil chemical fate and transport assumptions or extrapolations, it is necessary to hypothesize steady-state conditions over 30 years. Within the upper surface soil horizon where the spill was assumed to saturate the pore space, there must be . . .

- No volatilization of the seven volatile chemicals contained in the spill water;
- No dilution from infiltration of rainwater and snowmelt;
- No leaching of these chemicals to lower soil strata;
- No chemical or biological degradation in the soil matrix; and
- No other form of attenuation can occur.

Since the seven volatile COCs are apt to volatilize rapidly and otherwise attenuate rapidly to near-zero concentrations in the confined source area of the spill, the potential exists for exaggeration of upper-bound risks by many orders of magnitude.

A 10-gallon spill can be assumed to infiltrate to saturation in the upper 6 inches of soil with a surface area of, perhaps, 6 or 7 sq ft, or <0.2% of the area of a quarter-acre residential lot on which a future 30-year resident can ingest soil, make dermal contact with soil, and inhale soil particles.

As to incidental soil ingestion, it is necessary under proposed CDH guidance to assume that a child will ingest soil at a near-maximum rate *year-round* over a 6-year period, then continue ingesting soil as an adult year-round over a 24-year period, without regard to weather, all the while confined to the tiny area of the spill. CDH makes no provision for the site-specific FI factor or the Fraction Ingested from the contaminated source area, which is a standard factor in EPA's intake equation for soil ingestion. The impact of these rules is, in this instance at OU-2, likely to result in several orders of magnitude of reasonable worst-case risk exaggeration.

Similarly, as to dermal contact with soil, it is necessary to assume that a 30-year resident will contact surface soil year-round at a near-maximum rate of soil adherence to skin, with the head, hands, arms, legs and feet of the child exposed *year-round*, and thereafter with the head, hands, arms and lower legs of the adult exposed year-round. EPA has specified that the dermal exposure frequency should account for local weather conditions (RAGS, 1989). The implausibility of CDH assumptions is compounded by the overriding assumption that all dermal contact will occur over 30 years within the 6 to 7-sq-ft area of the spill at OU-2. Accordingly, it is not surprising that projected dermal contact risk exceeds the soil ingestion risk by an order of magnitude, while it is typical that soil ingestion will contribute more risk than dermal contact.

Other assumptions affecting the inhalation risks are similarly implausible, but the relative risk contributed by the inhalation route of exposure adds virtually no risk to total cancer and noncancer risks.

A further concern is that CDH screening rules are applied to COCs in soil much more conservatively than to the same COCs in water. By screening the route of exposure to chemicals in drinking water using the most stringent water quality standards, the risk screening levels applied to soil can be orders of magnitude lower and more restrictive than the equivalent risk levels of water quality standards. For example, one COC in the water spilled at OU-2 was carbon tetrachloride, with a Primary MCL (Maximum Contaminant Level) of 5 ug/L. While the maximum reported level of carbon tetrachloride in water at the OU-2 Field Treatability Unit was 3 ug/L, the standardized cancer risk level *at MCL* is set at 1E-5, based only on ingestion of water combined with inhalation of water volatiles released in household use of water (EPA Region 10, 1991).

Thus, the CDH screening rules are applied to carbon tetrachloride in water much more liberally (1E-5, not including the cancer effects of six other COCs and not including the dermal contact route of exposure), as compared to that same COC in soil (1E-6, including the cancer effects of all seven COCs and all routes of exposure). At OU-2, the *sum* of COC cancer risks from seven COCs in soil and three routes of exposure to soil COCs must not exceed the 1E-6 threshold. These two cancer risk screening levels—1E-6 for summed risks in soil and 1E-5 just for one COC in water are many orders of magnitude apart and illustrate that water is to be screened much more liberally than soil.

Presumably, the default values and equations specified by CDH serve the purpose of screening the potential risks at the level of a reasonable worst case, i.e., the bounding risk estimate for the MEI (Maximally Exposed Individual). EPA Exposure Assessment Guidelines (1992) stipulate the only utility of the bounding risk estimate is to eliminate certain environmental pathways and routes of exposure from a full risk assessment, i.e., to identify the risk-driving pathways and routes that will require detailed assessment. EPA states that a bounding estimate "certainly cannot be used for an estimate of actual exposure (since by definition it is clearly outside the actual distribution)." The actual risk distribution would include the *average* intakes and risks, as well as those for RME or Reasonable Maximum Exposure.

Although the bounding risk estimate is useful for screening out environmental pathways and routes of exposure that contribute insignificantly to overall risks, it should rely on credible assumptions. As a test for reaching a decision on the need for corrective action at a RCRA facility, the bounding estimate appears highly inappropriate. Further, the practice of mixing water quality standards presenting highly variable risk levels with uniform risk-based soil screening criteria appears highly inconsistent.

ATTACHMENT TO
RESOURCE CONSERVATION AND RECOVERY ACT
CONTINGENCY PLAN IMPLEMENTATION REPORT
NO. 94-004

SOIL RISK ASSESSMENT

REVISED BOUNDING RISK ASSESSMENT FOR OPERABLE UNIT NO. 2 TREATABILITY SYSTEM SPILL

A revised risk assessment was performed on the small spill of water present in the Operable Unit No. 2 (OU 2) Treatability System. Instead of using chemical concentrations in water, the revised assessment is based on extrapolated chemical concentrations in soil, as requested by the Colorado Department of Health.

Attached are the computer spreadsheets for a screening-level assessment of human health risks. The spreadsheet format, exposure parameters, parameter default values and the intake equations follow the CDH Interim Final Guidance for risk assessments used to determine the need for a Corrective Measures Study (CMS) at a RCRA facility (CDH, 1993).

As shown in the lower right-hand corner of Table 2, the estimated upper-bound total added cancer risk from ingestion of soil, dermal contact with soil, and inhalation of soil particles by the future on-site resident at OU 2 is between 1E-7 and 1E-8, or an added cancer incidence between 1 in 10 million and 1 in 100 million. The risk screening threshold proposed by CDH for making a determination of need for a CMS is a cumulative risk of 1E-6. Thus, using the CDH screening-level risk assessment methodology, the small spill at OU 2 appears to present a potential cancer risk level at least one order of magnitude less than the CDH screening threshold.

As shown in the lower right-hand corner of Table 3, the estimated upper-bound total HQ (Hazard Quotient) for noncancer health effects is between 1E-02 and 1E-03, or between 0.1% and 1% of the cumulative risk screening threshold proposed by CDH (HQ=1). Thus, using the CDH methodology, the small spill at OU 2 appears to present a potential noncancer health risk level at least two orders of magnitude less than the CDH screening threshold.

Because measured soil concentrations of seven COCs (Chemicals of Concern) identified in the water spilled at the OU 2 Field Treatability Unit were unavailable, it was necessary to extrapolate maximum surface soil concentrations on the very conservative basis of 40% soil moisture at saturation; i.e., the measured water concentrations were multiplied by 0.4 to estimate maximum soil concentrations. A maximum soil moisture of 40% is generally typical of a moderately compacted soil; actual maximum soil moisture recorded at OU 2 is about 30%, with an average nearer to 20%, according to OU 2 records.

This specific application of CDH's proposed RCRA screening-level risk assessment methodology to a very small spill at OU 2 (viz., 10 gallons) appears to indicate no need for a CMS, at least on the basis of soil-related risks (CDH proposes that water will be screened on the basis of an ARAR rather than a risk level). Still, it appears that the risk levels projected using the CDH methodology can overstate the reasonable upper-bound risks by many orders of magnitude. As a means of supporting this conclusion, the exposure assessment scenario implicit in the CDH default exposure factors and intake questions is outlined in Attachment 2 as it applies to the 10-gallon spill at OU 2.

TABLE 1

RESIDENTIAL EXPOSURE QUANTIFICATION--Intake Calculation: OU-2 Spill at Field Treatability Unit

	cis-1,2 DCE		1,1 DCA		TCE		PCE	
Modelled:								
Surface Soil (mg/kg) (1)	3.60E-03	3.60E-03	3.20E-04	3.20E-04	1.20E-03	1.20E-03	8.00E-04	8.00E-04
Airborne Soil Particulates (mg/m3) (2)	7.80E-07	7.80E-07	6.40E-08	6.40E-08	2.60E-07	2.60E-07	1.70E-07	1.70E-07
Indoor Airborne Soil VOCs (mg/m3)	NA	NA	NA	NA	NA	NA	NA	NA
SOIL INGESTION:								
Child Intake (mg/kg-d) (3)(4)	4.60E-07	3.95E-08	4.09E-08	3.51E-09	1.53E-07	1.32E-08	1.02E-07	8.77E-09
Adult Intake (mg/kg-d) (5)(6)	4.93E-08	1.69E-08	4.38E-09	1.50E-09	1.64E-08	5.64E-09	1.10E-08	3.76E-09
TOTAL INTAKE	5.10E-07	5.64E-08	4.53E-08	5.01E-09	1.70E-07	1.88E-08	1.13E-07	1.25E-08
SOIL DERMAL CONTACT:								
Child Intake (mg/kg-d) (7)(8)	5.28E-06	4.54E-07	4.71E-07	4.03E-08	1.76E-06	1.51E-07	1.18E-06	1.01E-07
Adult Intake (mg/kg-d) (9)(10)	1.75E-06	6.00E-07	1.56E-07	5.34E-08	5.84E-07	2.00E-07	3.89E-07	1.33E-07
TOTAL INTAKE	7.04E-06	1.05E-06	6.26E-07	9.37E-08	2.35E-06	3.51E-07	1.57E-06	2.34E-07
SOIL PARTICLE INHALATION:								
Child Intake (mg/kg-d) (11)(12)	1.69E-15	1.62E-16	1.55E-16	1.33E-17	6.29E-16	5.39E-17	4.11E-16	3.52E-17
Adult Intake (mg/kg-d) (13)(14)	4.60E-16	1.58E-16	3.77E-17	1.29E-17	1.53E-16	5.25E-17	1.00E-16	3.44E-17
TOTAL INTAKE	2.35E-15	3.19E-16	1.93E-16	2.62E-17	7.82E-16	1.06E-16	5.11E-16	6.96E-17

Max Concentration (Cmax) at SWMU [illegible]			Contaminant of Concern (COC)			
	Carbon Tet		Chloroform		Toluene	
Modelled:						
Surface Soil (mg/kg) (1)	1.20E-03	1.20E-03	2.80E-04	2.80E-04	1.60E-04	1.60E-04
Airborne Soil Particulates (mg/m3) (2)	2.60E-07	2.60E-07	6.00E-08	6.00E-08	3.50E-08	3.50E-08
Indoor Airborne Soil VOCs (mg/m3)	NA	NA	NA	NA	NA	NA
Route Exposure and Intake (mg/kg-d)	Noncarcinogenic (NCI)	Carcinogenic (CI)	Noncarcinogenic (NCI)	Carcinogenic (CI)	Noncarcinogenic (NCI)	Carcinogenic (CI)
SOIL INGESTION:						
Child Intake (mg/kg-d) (3)(4)	1.53E-07	1.32E-08	3.58E-08	3.07E-09	2.05E-08	1.75E-09
Adult Intake (mg/kg-d) (5)(6)	1.64E-08	5.64E-09	3.84E-09	1.32E-09	2.19E-09	7.51E-10
TOTAL INTAKE	1.70E-07	1.88E-08	3.96E-08	4.38E-09	2.26E-08	2.50E-09
SOIL DERMAL CONTACT:						
Child Intake (mg/kg-d) (7)(8)	1.78E-08	1.51E-07	4.12E-07	3.53E-08	2.35E-07	2.02E-08
Adult Intake (mg/kg-d) (9)(10)	5.84E-07	2.00E-07	1.36E-07	4.67E-08	7.78E-08	2.67E-08
TOTAL INTAKE	2.35E-06	3.51E-07	5.48E-07	8.20E-08	3.13E-07	4.68E-08
SOIL PARTICLE INHALATION:						
Child Intake (mg/kg-d) (11)(12)	6.29E-16	5.39E-17	1.45E-16	1.24E-17	8.47E-17	7.26E-18
Adult Intake (mg/kg-d) (13)(14)	1.53E-16	5.25E-17	3.54E-17	1.21E-17	2.06E-17	7.07E-18
TOTAL INTAKE	7.82E-16	1.06E-16	1.81E-16	2.46E-17	1.05E-16	1.43E-17

Note: (1) Cmax (mg/kg) = Cmax (mg/L)*0.4 (40% soil moisture at saturation in moderately compacted soil).

Note: (2) Cmax (mg/m3) = Cmax (mg/kg)/4630 m3/mg (PEF, particulate emission factor from EPA RAGS, Part B).

Note: (3) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.3E-4 (CDH RCRA standard default intake factor).
(4) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.1E-5 (CDH).

Note: (5) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*1.4E-5 (CDH).
(6) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*4.7E-6 (CDH).

Note: (7) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.5E-3 (CDH).
(8) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.3E-4 (CDH).

Note: (9) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*4.9E-4 (CDH).
(10) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*1.7E-4 (CDH).

Note: (11) Imax (Child NC, mg/kg-d) = Cmax (mg/kg)*1.9E-15 (CDH).
(12) Imax (Child C, mg/kg-d) = Cmax (mg/kg)*1.6E-16 (CDH).

Note: (13) Imax (Adult NC, mg/kg-d) = Cmax (mg/kg)*4.6E-16 (CDH).
(14) Imax (Adult C, mg/kg-d) = Cmax (mg/kg)*1.6E-16 (CDH).

TABLE 2 RESIDENTIAL RISK CHARACTERIZATION-- Risk Calculation for Carcinogens: OU-2 Spill at Field Treatability Unit							
	Contaminant--Carcinogen						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SOIL INGESTION							
Total Intake (mg/kg-day)*	5.64E-08	5.01E-09	1.88E-08	1.25E-08	1.88E-08	4.38E-09	2.50E-09
Slope Factor (mg/kg-day)-1=	NA	NA	1.10E-02	5.20E-02	1.30E-01	6.10E-03	NA
Added Cancer Risk	NA	NA	2.07E-10	6.51E-10	2.44E-09	2.67E-11	NA
SOIL DERMAL CONTACT							
Total Intake (mg/kg-day)*	1.05E-06	9.37E-08	3.51E-07	2.34E-07	3.51E-07	8.20E-08	4.68E-08
Slope Factor (mg/kg-day)-1=	NA	NA	1.10E-02	5.20E-02	1.30E-01	6.10E-03	NA
Added Cancer Risk	NA	NA	3.86E-09	1.22E-08	4.57E-08	5.00E-10	NA
SOIL PARTICLE INHALATION							
Total Intake (mg/kg-day)*	3.19E-16	2.62E-17	1.06E-16	6.96E-17	1.06E-16	2.46E-17	1.43E-17
Slope Factor (mg/kg-day)-1=	NA	NA	6.00E-03	2.00E-03	5.30E-02	8.10E-02	NA
Added Cancer Risk	NA	NA	8.39E-19	1.39E-18	5.64E-18	1.99E-18	NA
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL RESIDENTIAL ADDED CANCER RISK							[illegible]

TABLE 3

RESIDENTIAL RISK CHARACTERIZATION--

Risk Calculation for Noncarcinogens: OU-2 Spill at Field Treatability Unit

	Contaminant--Noncarcinogen						
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SOIL INGESTION							
Total Intake (mg/kg-day)/	5.10E-07	4.53E-08	1.70E-07	1.13E-07	1.70E-07	3.96E-08	2.26E-08
Reference Dose (mg/kg-day)=	1.00E-02	1.00E-01	NA	1.00E-02	7.00E-04	1.00E-02	2.00E-01
Hazard Quotient	5.1E-05	4.53E-07	NA	1.13E-05	2.43E-04	3.96E-06	1.13E-07
SOIL DERMAL CONTACT							
Total Intake (mg/kg-day)/	7.04E-06	6.26E-07	2.35E-06	1.57E-06	2.35E-06	5.48E-07	3.13E-07
Reference Dose (mg/kg-day)=	1.00E-02	1.00E-01	NA	1.00E-02	7.00E-04	1.00E-02	2.00E-01
Hazard Quotient	7.04E-04	6.26E-06	NA	1.57E-04	3.35E-03	5.48E-05	1.57E-06
SOIL PARTICLE INHALATION							
Total Intake (mg/kg-day)/	2.35E-15	1.93E-16	7.82E-16	5.11E-16	7.82E-16	1.81E-16	1.05E-16
Reference Dose (mg/kg-day)=	NA	1.00E-01	NA	NA	NA	NA	NA
Hazard Quotient	NA	1.93E-15	NA	NA	NA	NA	NA
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
TOTAL RESIDENTIAL HAZARD QUOTIENT							[illegible]